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EXAMINER
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ART UNIT	PAPER NUMBER
2622	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/23/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

PTOL-90A (Rev. 10/06)

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☐ Responsive to communication(s) filed on _____.

2a) ☐ This action is **FINAL**.   2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *1-38* is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *1-11,14-18,20,21,23-31 and 33-38* is/are rejected.

7) ☒ Claim(s) *12,13,19,22 and 32* is/are objected to.

8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☒ The drawing(s) filed on *22 December 2003* is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a) ☐ All   b) ☐ Some * c) ☐ None of:

      1. ☐ Certified copies of the priority documents have been received.

      2. ☐ Certified copies of the priority documents have been received in Application No. _____.

      3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
    Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413)
    Paper No(s)/Mail Date _____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1.   Claims 17, 20, and 31 are objected to because of the following informalities:

- In claim 17 on line 2, "the given including:" should probably read, -- the given

  pixel, including: --.

- In claim 20 on line 5, "the fist color" should probably read, -- the first color --.

- In claim 31 on line 5, "the fist color" should probably read, -- the first color --.

Appropriate correction is required.

2.   Claim 21 is objected to as failing to comply with 37 CFR 1.75(a) for failing to

particularly point out and distinctly claim the subject matter which Applicant regards as the

invention.

Claim 21 recites the limitation "the demosaic image" on line 3. There is insufficient

antecedent basis for this limitation in the claim. For examination purposes, the claim will be

treated as if it reads, "the output image".

Claim Rejections - 35 USC § 101

3.   35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or
any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and
requirements of this title.

4.   Claims 37-38 are rejected under 35 U.S.C. 101 because the claimed invention is directed

to non-statutory subject matter.

Claims 37-38 define an article (further specified as a memory) for instructing a processor

to process an image. However, the claim does not define a <u>computer-readable</u> medium or

memory and is thus non-statutory. That is, the scope of the presently claimed "article" can range

from paper on which the program is written, to a program simply contemplated and memorized

by a person.

Claim Rejections - 35 USC § 112

5.   Claims 22 and 32 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite

for failing to particularly point out and distinctly claim the subject matter which Applicant

regards as the invention.

Claim 22 recites the limitation "the intensity gradient" on lines 5-6. There is insufficient

antecedent basis for this limitation in the claim. For examination purposes, the claim will be

treated as if it reads, "an intensity gradient".

Claim 32 recites the limitation "the intensity gradient" on line 7. There is insufficient

antecedent basis for this limitation in the claim. For examination purposes, the claim will be

treated as if it reads, "an intensity gradient".

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the

basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1-8, 10, 11, 14-18, 23-30, and 33-38 are rejected under 35 U.S.C. 102(e) as being

anticipated by Kakarala (U.S. Patent Application Publication No. 2003/0052981).

Regarding **claims 1, 23, and 33**, Kakarala discloses a method of processing a digital

image, each pixel of the digital image having only a single sampled value (see paragraph 29), the

method comprising interpolating values of a first color (green) at pixels where the first color was

not sampled (see paragraph 35), the interpolation of the first color value at a given pixel (red

pixel R_1; see paragraph 53) including:

determining likelihoods (the degree of fit λ; see paragraph 58 and equation

9) of the given pixel belonging to the same region as each of at least two other

pixels having sampled values of the first color (the green pixels on each side of

red pixel R_1; see paragraphs 53-54), the other pixels in different directions relative

to the given pixel (green pixels are located north, south, east, and west of red pixel

R_1; see paragraph 53); and

using the likelihoods and the sampled values of the other pixels to

interpolate the first color at the given pixel (see paragraphs 54-64).

Regarding **claim 2**, Kakarala discloses:

at least two of the directions are orthogonal (the green pixels on each side

of red pixel R_1 are used; see paragraphs 53-54).

Regarding **claim 3**, Kakarala discloses:

the directions include north, south, east and west of the given pixel (see

paragraphs 53-54).

Regarding **claim 4**, Kakarala discloses:

the sampled pixel values are of neighboring pixels nearest the given pixel

(see paragraphs 53-54).

Regarding **claims 5 and 24**, Kakarala discloses:

additionally using sampled values of a second color to compute terms for

correcting the sampled values of the first color (the Jacobian matrix in Figure 6,

which is comprised of all colors, is used to correct the raw green data; see

paragraph 96).

Regarding **claims 6 and 25**, Kakarala discloses:

using the sampled values of the second color to correct a sampled value of

the first color includes taking a difference between the sampled value at the given

pixel and the sampled value of the second color at a neighbor, the neighbor lying

in the same direction as the pixel being corrected (the gradients in equation 6 are

calculated as described in paragraph 54).

Regarding **claims 7 and 26**, Kakarala discloses:

the likelihoods are used to compute a weighted average of the sampled

values and correction terms (see paragraphs 63-64).

Regarding **claims 8 and 27**, Kakarala discloses:

determining the likelihoods includes applying a similarity function to

differences between sampled values (see paragraphs 58-59 and equation 9).

Regarding **claim 10**, Kakarala discloses:

the likelihoods are used to compute a weighted average of the sampled

values (see paragraphs 85-88 and equation 17).

Regarding **claims 11 and 28**, Kakarala discloses:

the first color is green, whereby missing information in a green color plane

is interpolated (see paragraph 35).

Regarding **claim 14**, Kakarala discloses:

the digital image corresponds to a Bayer CFA (see paragraph 29).

Regarding **claims 15 and 29**, Kakarala discloses:

interpolating at least one other color at each pixel (see paragraph 30).

Regarding **claim 16**, Kakarala discloses:

the likelihoods are used to interpolate missing information in one color

plane (green; see paragraphs 54-64), and wherein bilinear interpolation is used to

interpolate missing information in other color planes (see paragraph 37), wherein

the interpolation includes using sampled and interpolated green pixel values (see

paragraph 36).

Regarding **claims 17 and 30**, Kakarala discloses interpolating additional missing values, the interpolation of a second color value (red or blue) at the given pixel including:

> using sampled and interpolated first color values to determine likelihoods of the given pixel belonging to the same region as neighboring pixels (see paragraphs 36-38 and 58); and

> using the likelihoods and sampled second color values in the neighborhood to interpolate the second color value at the given pixel (see paragraphs 36-38 and 58).

Regarding **claim 18**, Kakarala discloses:

> computing correction terms (see paragraph 54); and

> using the correction terms to correct the sampled second color values in the neighborhood (the Jacobian matrix in Figure 6, which is comprised of all colors, is used to correct the raw green data; see paragraph 96).

Regarding **claim 34**, Kakarala discloses:

> means for aquiring the mosaic image (image sensor 20; see paragraph 29).

Regarding **claim 35**, Kakarala discloses a digital camera (digital image system 10; see paragraph 28) comprising:

> a photosensor array (image sensor 20) for acquiring mosaic images (see paragraph 29); and

> a digital signal processor (40) for processing the mosaic images, the processing including interpolating missing values from sampled values in the mosaic image (see paragraph 35), the interpolation of a given pixel (red pixel R_1;

see paragraph 53) in a given color plane (green) including determining the
likelihoods (the degree of fit λ) of neighbors belonging to the same region as the
given pixel (see paragraph 58 and equation 9), the neighbors being in at least two
different directions relative to the given pixel (green pixels are located north,
south, east, and west of red pixel R_1; see paragraph 53); and using the likelihoods
and the sampled values of the neighbors to interpolate the given color at the given
pixel (see paragraphs 54-64).

Regarding **claim 36**, Kakarala discloses:

the processing includes using sampled values of a second color to compute
terms for correcting the sampled values of the given color (the Jacobian matrix in
Figure 6, which is comprised of all colors, is used to correct the raw green data;
see paragraph 96).

Regarding **claim 37**, Kakarala discloses an article for instructing a processor to process a
mosaic image (see paragraph 28), the article comprising:

memory encoded with instructions for instructing the processor (see *id.*) to
interpolate missing values of a first color (green), the interpolation of the first
color of a given pixel (red pixel R_1; see paragraph 53) including determining
likelihoods (the degree of fit λ) of neighbors having sampled values of the first
color being in the same region as the given pixel (see paragraph 58 and equation
9), and using the sampled values and the likelihoods of those neighbors to
interpolate the first color at the given pixel (see paragraphs 54-64), at least one
neighbor being in a first direction relative to the given pixel, at least one neighbor

being in a second direction relative to the given pixel, where the first and second

directions are orthogonal (the green pixels used are located north, south, east, and

west of red pixel R_1; see paragraph 53).

Regarding **claim 38**, Kakarala discloses:

the processing includes using sampled values of a second color to compute

terms for correcting the sampled values of the first color (the Jacobian matrix in

Figure 6, which is comprised of all colors, is used to correct the raw green data;

see paragraph 96).

Claim Rejections - 35 USC § 103

8.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in
section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are
such that the subject matter as a whole would have been obvious at the time the invention was made to a person
having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the
manner in which the invention was made.

9.   This application currently names joint inventors. In considering patentability of the

claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various

claims was commonly owned at the time any inventions covered therein were made absent any

evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out

the inventor and invention dates of each claim that was not commonly owned at the time a later

invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c)

and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

10.   Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kakarala in view

of Stavely (U.S. Patent Application Publication No. 2004/0240726).

Claim 9 can be treated like claim 8. While Kakarala determines the likelihoods of a

given pixel belonging to the same region as two other pixels in order to perform demosaicing

(described *supra*), he is silent with regard to including a lookup table.

Stavely discloses a system that performs demosaicing. As described in paragraphs 41

and 42, demosaicing is performed using coefficients stored in a table in database 224 that

account for the location of the pixel under consideration.

An advantage of looking up such values is that less computation is necessary. For this

reason, it would have been obvious to one of ordinary skill in the art at the time the invention

was made to have Kakarala's system include the lookup table described by Stavely.

11.   Claims 20, 21, and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over

Kakarala in view of Hel-or (U.S. Patent No. 6,404,918).

Claims 20 and 31 can be treated like claims 15 and 23, respectively. While Kakarala

discloses performing luminance smoothing (see paragraph 96), he is silent with regard to

estimating, transforming, smoothing, transforming, and resetting the pixels.

Hel-or discloses an image demosaicing method (see Figure 3), wherein interpolating at

least one of the other missing colors includes:

making an initial estimate for the other missing colors (see column 6, lines

30-32);

transforming an output image into a luminance-chrominance color space,

the output image including sampled and interpolated values of the fist color, and

sampled values of the other colors (see column 6, lines 32-34);

smoothing the luminance and chrominance bands (see column 6, lines 34-

38);

transforming the output image back to its original color space (see column

6, lines 38-39); and

resetting measured values and green interpolated values in the output

image (see column 6, lines 40-42).

As stated in column 1, line 65, through column 2, line 3, an advantage of performing this

procedure is that color artifacts are reduced and resolution around boundaries are improved. For

this reason, it would have been obvious to one of ordinary skill in the art at the time the invention

was made to have Kakarala's system perform the procedure described by Hel-or.

Regarding **claim 21**, Hel-or discloses:

each step is a linear operation, and wherein the steps are performed by

applying a concatenation of the linear operations to the demosaic image (see

column 6, lines 53-56).

Allowable Subject Matter

12.   Claims 12, 13, 19, 22, and 32 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

     Regarding **claims 12, 13, 19, 22, and 32**, no prior art could be located that teaches or fairly suggests a digital image interpolation method/apparatus with the recited equations.

Conclusion

13.   The prior art made of record and not relied upon is considered pertinent to Applicant's disclosure.

14.   Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason Whipkey, whose telephone number is (571) 272-7321. The examiner can normally be reached Monday through Friday from 9:00 A.M. to 5:30 P.M. eastern daylight time.

     If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vivek Srivastava, can be reached at (571) 272-7304. The fax phone number for the organization where this application is assigned is (571) 273-8300.

     Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished

applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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